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RADIUM MONITORING NETWORK

DATA RELEASE NUMBER 9

PUBLIC HEALTH SERVICE, DENVER, COLORADO

JULY 1966

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RADIUM MONITORING NETWORK

DATA RELEASE NO. 9

U. S. DEPARTMENT OF INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
COLORADO RIVER BASIN WATER QUALITY CONTROL PROJECT
DENVER, COLORADO

JULY 1966

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16. Abstracts
In this ninth data release report, radium-226 and uranium results are presented that supplement data from eight previous releases dated October 1962 through January 1966. The data indicate evidence of uranium mining and milling from analysis of composite water samples at stations of the Radium Monitoring Network of the Colorado River Basin Water Quality Control Project. The network is a surveillance system consisting of continuous surface water sampling at 27 locations throughout the basin. It assays the radiological content of river water over the entire basin. Tabular data are given.

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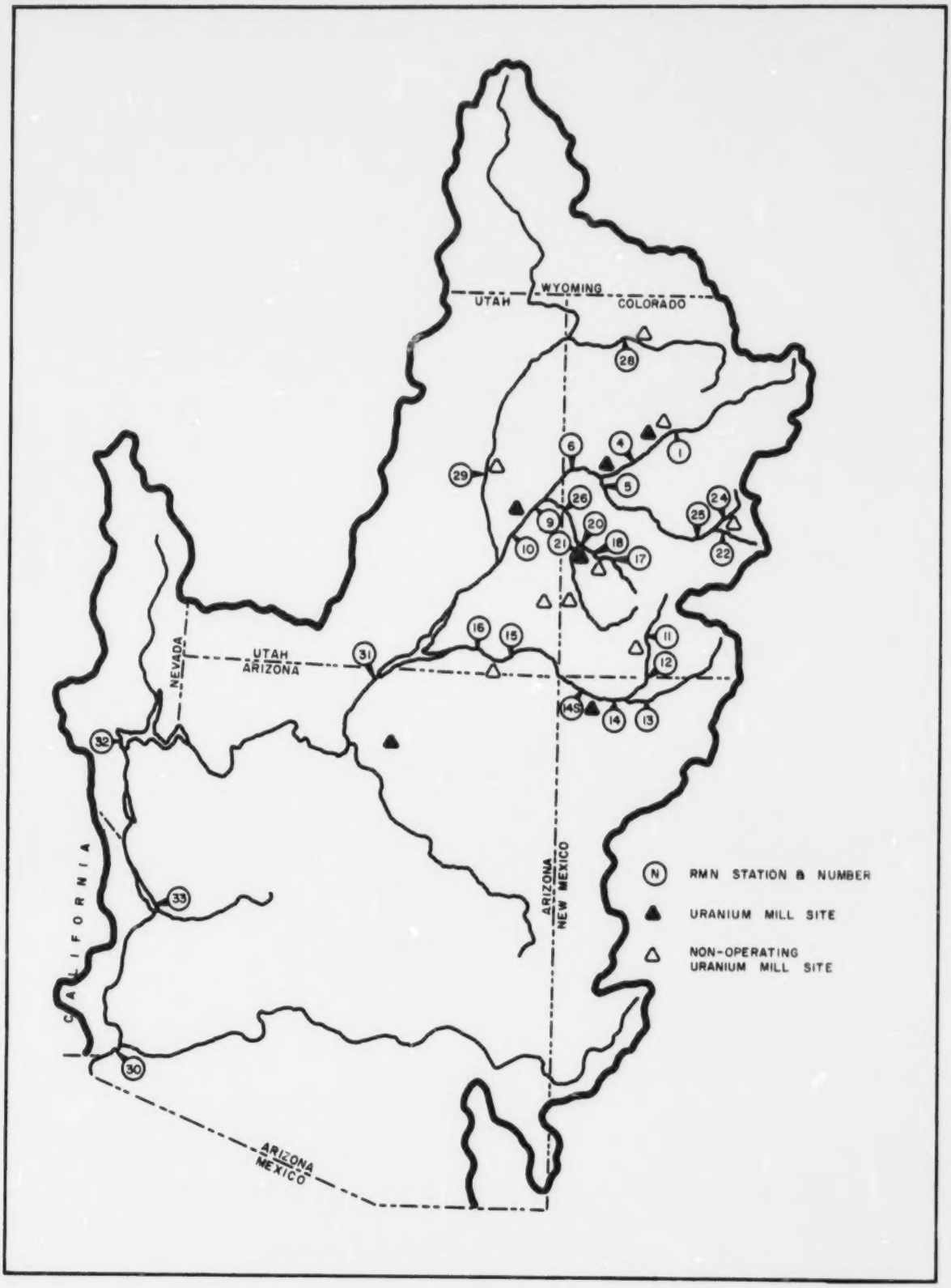


GPO 851-409

COLORADO RIVER BASIN RADIUM MONITORING NETWORK

COLORADO RIVER BASIN WATER QUALITY CONTROL PROJECT

RADIUM MONITORING NETWORK DATA RELEASE NO. 9

INTRODUCTION

This is the ninth release of data collected through the Radium Monitoring Network, which is maintained by the Colorado River Basin Water Quality Control Project, Federal Water Pollution Control Administration. The purpose of this release is to supplement data given in the eight previous releases dated October 1962 through January 1966.

A summary report of Radium Monitoring Network data collected through December 1963 was published in the November 1964 edition of Radiological Health Data, copies of which are now available through Colorado River Basin Project Headquarters. A similar report of data collected through December of 1964 was published in the November 1965 edition of the same periodical, and reprints are available through the U. S. Government Printing Office.

The Radium Monitoring Network is a surface water surveillance system currently consisting of twenty-one sampling stations located on various streams and reservoirs throughout the Colorado River Basin. During initial stages of the surveillance program, the system consisted of twenty-seven sampling stations. The purpose of the network is to provide continuous monitoring of Basin surface water radioactivity concentrations resulting primarily from uranium mining and milling industry waste discharges. Samples are analyzed for radium-226, uranium, gross alpha, gross beta, thorium alpha, lead-210, and strontium-90, to provide a comprehensive picture of uranium industry radiological contaminants and nuclear weapons testing fallout contributions to Colorado River Basin surface waters.

SAMPLING PROCEDURES

Depending on individual station parameters, Radium Monitoring Network (RMN) samples are collected as either automatic or grab samples. Grab samples are collected once or three times per week, and automatic samplers collect 21 ml portions every hour. The samples are sent "as is" to the Colorado River Basin Project Laboratory where they are composited and filtered through 0.45 micron membrane filters as soon as possible after the samples for a compositing period are received. After filtration, they are acidified with 2 percent by volume of 12 N HCL and radiochemical determinations are then performed on the filtered water.

RESULTS

The Appendix contains the dissolved radium-226 and uranium data appended to the data presented in the eight previous data releases, and a summary of all radium-226 and uranium data collected to

date is given in Table 1. Gross alpha, gross beta, lead-210, thorium alpha and strontium-90 data collected through June 1965 were reported in Data Releases Nos. 7 and 8, and no additional data on these parameters are presented in this release.

In general, radium-226 and uranium concentrations at all stations continued to average well below recommended maximum concentrations. Only one station, the Dolores River at Gateway, Colorado, continued to carry an overall radium-226 concentration average above one picogram per liter, although its average for this reporting period decreased to 0.61 picograms per liter. All but three of the remaining stations continued to carry average concentrations little different from those found throughout the four-and-one-half-year monitoring period. The three stations where significant change or variation has occurred are located on the Animas River at the Colorado-New Mexico State Line, the San Miguel River below Uravan, Colorado, and Lake Mead at Hoover Dam.

The Animas and San Miguel River stations both produced lower average radium-226 concentrations for the monitoring period covered herein (August 1965 through April 1966) than for the overall period of monitoring. Concentrations at the Animas River station decreased from an overall average of 0.26 picogram per liter to 0.09 picogram per liter for this reporting period, and the San Miguel River concentrations below Uravan decreased from an overall average of 0.83 picogram per gram (with earlier averages above one picogram per liter) to 0.47 picogram per liter for this reporting period. The Animas River decrease resulted from discontinuing of upstream pollution following shutdown of the Durango, Colorado uranium mill in 1963, and the San Miguel River decrease is a result of additional pollution abatement measures taken at the still operating Uravan, Colorado uranium mill in the same year. These measures consisted of placing a large portion of the mill's liquid wastes in seepage-evaporation disposal ponds, rather than discharging the waste to the San Miguel River.

The variation in radium-226 concentrations in Lake Mead was in the opposite direction, showing an increase from a stable average of about 0.33 picogram per liter during 1963 and 1964 (Data Release No. 8) to 0.47 picogram per liter for this reporting period. As shown in Figure 1, the 1963 and 1964 month-to-month radium-226 concentrations in Lake Mead varied only slightly. Monthly concentrations then began to slowly increase through 1965, reaching a peak of about 0.60 picogram per liter in January 1966, and then decreasing to levels between 0.40 and 0.50 picogram per liter during the early months of 1966.

The increased concentrations are well below the 3 picocuries per liter U. S. Public Health Service Drinking Water Standard limit for radium-226. However, the noted increases in concentrations raise questions as to their cause and future trends. Current data are not sufficient to permit definite conclusions regarding the increases. Therefore, in addition to the regular Lake Mead monitoring at Radium Monitoring Network station number 32, the Colorado River Basin Water Quality Control Project is conducting special water and sediment sampling surveys of

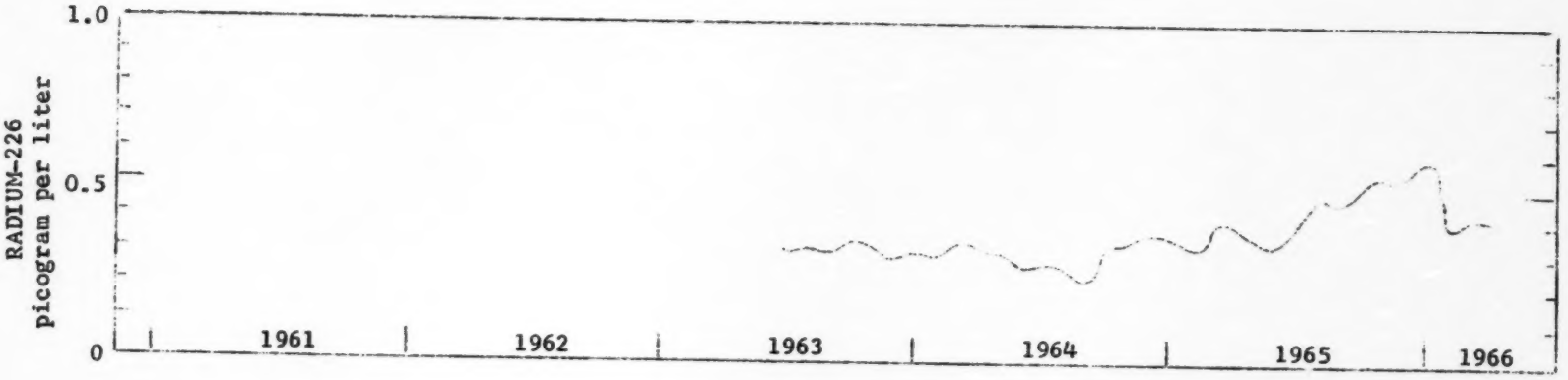
Lake Mead and inflowing streams to obtain information which may identify the cause of the noted concentration increase and provide an indication of future concentration trends. Data obtained from the surveys will be presented in ensuing Data Releases as the studies progress.

TABLE 1 - Radium 226 and uranium in surface waters of the Colorado River Basin

Station Number and Location	Radium-226 Avg.[1] pg/l	Radium-226 Range pg/l	Radium-226 No. of Analyses	Uranium Avg.[1] µg/l	Uranium Range µg/l	Uranium No. of Analyses
Animas River						
#11 above Durango, Colo.	0.05	0.01-0.11	52	1.2	0.1- 2.5	46
#12 Colorado-New Mexico State Line	0.26[2]	0.05-1.5	104	3.6	0.0- 18	61
Colorado River						
#1 at Silt, Colorado	0.19	0.04-0.39	57	3.4	0.0- 4.4	43
#4 at DeBeque, Colorado	0.19	0.05-0.44	58	3.6	0.4- 7.2	43
#6 at Fruita, Colorado	0.18	0.09-0.40	52	8.6	2.0- 14	43
#9 above Moab, Utah	0.26	0.10-0.50	86	9.8	2.6- 17	73
#10 below Moab, Utah	0.31	0.16-7.2	81	11	3.0- 22	69
#31 at Page, Arizona	0.21	0.10-0.31	35	7.4	2.8- 13	35
#32 Lake Mead	0.36[3]	0.21-0.60	38	8.6	5.6- 11	38
#33 Lake Havasu	0.36	0.06-0.44	40	8.2	5.7- 11	40
#30 at Yuma, Arizona	0.17	0.06-0.33	48	8.2	4.9- 11	43
Dolores River						
#21 at Bedrock, Colorado	0.45	0.03-1.4	55	11	0.6- 35	42
#26 at Gateway, Colorado	1.1	0.04-3.2	94	13	0.1- 51	71
Green River						
#28 below Maybell, Colo.	0.09	0.03-0.15	36	2.7	0.6- 8.0	32
#29 below Green River, Utah	0.09	0.05-0.15	29	5.0	1.6- 7.6	26
Gunnison River						
#24 above Gunnison, Colo.	0.04	0.01-0.08	43	1.2	0.0- 2.6	33
#25 below Gunnison, Colo.	0.04	0.01-0.09	46	2.3	0.6- 4.3	33
# 5 at Grand Junction, Colo.	0.09	0.01-0.30	50	10	0.7- 19	43
San Juan River						
#13 above Farmington, N.M.	0.07	0.03-0.16	20	2.8	0.0- 8.3	19
#14 below Farmington, N.M.	0.08	0.03-0.21	44	2.9	0.3- 9.0	43
#14S below Shiprock, N.M.	0.08	0.03-0.26	153	9.6	0.1- 93	149
#15 above Mexican Hat, Utah	0.13	0.04-0.66	51	6.7	2.1- 23	38
#16 below Mexican Hat, Utah	0.13	0.01-0.84	129	9.1	0.8- 35	111
San Miguel River						
#17 above Naturita, Colo.	0.04	0.00-0.19	71	1.6	0.0-3.9	43
#18 above Uravan, Colo.	0.22	0.05-1.2	104	6.3	0.9- 63	73
#20 below Uravan, Colo.	0.83[3]	0.06-5.6	215	25	0.0-150	187

1/ Average concentration obtained from all data presented in this and previous data releases.
2/ Average 0.09 pg/liter for this reporting period (August 1965 through April 1966).
3/ Average 0.47 pg/liter for this reporting period (August 1965 through April 1966).

FIGURE 1 - Radium-226 in Lake Mead



APPENDIX

RMN Station 1: Colorado River at Silt, Colorado
Started: November 25, 1961
Type: Automatic Pump-Timer

Date	Radium-226 pg/liter	Uranium µg/liter
1965		
August 27 - October 2	0.11	3.9
October 2 - October 29	0.15	4.2
October 29-November 27	0.18	3.6
November 27-January 2	0.18	3.0
1966		
January 2-January 29	0.21	1.9
January 29-February 27	0.18	2.1
February 27-April 2	0.15	0.0
April 2-April 30	0.14	1.9

RMN Station 4: Colorado River above DeBeque, Colorado
Started: November 12, 1961
Type: Automatic Pump-Timer

Date	Radium-226 pg/liter	Uranium µg/liter
1965		
August 28-October 2	0.15	4.6
October 2-October 30	0.13	4.0
October 30-November 27	0.20	2.3
November 27-January 2	0.19	2.5
1966		
January 2-January 29	0.20	4.7
January 29-February 27	0.20	2.9
February 27-April 2	0.14	0.6
April 2-April 30	0.14	2.6

RMN Station 5: Gunnison River above Grand Junction, Colorado
Started: April 16, 1962
Type: Three grab samples per week

Date	Radium-226 pg/liter	Uranium µg/liter
1965		
August 30-October 1	0.04	9.7
October 4-October 29	0.03	12
November 1-November 26	0.04	15
November 29-December 31	0.09	12
1966		
January 3-January 28	0.08	18
January 31-February 25	0.05	14
February 28-April 1	0.05	9.0
April 4-April 29	0.08	4.4

RMN Station 6: Colorado River near Fruita, Colorado
Started: April 16, 1962
Type: Three grab samples per week

Date	Radium-226 pg/liter	Uranium µg/liter
1965		
August 30-October 1	0.13	9.3
October 4-October 29	0.14	10
November 1-November 26	0.12	7.8
November 29-December 31	0.40	8.1
1966		
January 3-January 28	0.16	7.1
February 2-February 25	0.12	6.0
February 28-April 1	0.15	5.6
April 4-April 30	0.11	4.7

RMN Station 9: Colorado River above Moab, Utah
Started: December 11, 1961
Type: Three grab samples per week

Date	Radium-226 pg/liter	Uranium µg/liter
1965		
August 30-October 1	0.20	9.7
October 4-October 29	0.14	11
November 1-November 26	0.20	8.9
November 29-December 31	0.30	8.0
1966		
January 3-January 28	0.37	8.5
January 31-February 25	0.25	6.2
February 28-April 1	0.25	4.8
April 4-April 29	0.19	4.5

RMN Station 10: Colorado River below Moab, Utah
Started: December 11, 1961
Type: Three grab samples per week

Date	Radium-226 pg/liter	Uranium µg/liter
1965		
August 30-October 1	0.23	12
October 4-October 29	0.16	11
November 1-November 26	0.34	14
November 29-December 31	0.42	9.1
1966		
January 3-January 28	0.28	11
January 31-February 25	0.32	12
February 28-April 1	0.22	5.5
April 4-April 29	0.22	6.3

RMN Station 11: Animas River at Durango, Colorado
Started: July 17, 1961
Type: One grab sample per week

Date	Radium-226 pg/liter	Uranium µg/liter
1965		
August 6-August 20	0.03	1.4
September 3-October 1	0.05	2.2
October 8-October 29	0.05	2.1
November 5-November 26	0.04	0.6
December 3-December 31	0.04	1.8
1966		
January 7-January 28	0.03	1.1
February 4-February 25	0.04	1.0
March 4-April 1	0.04	1.3
April 8-April 29	0.03	1.1

RMN Station 12: Animas River at Colorado-New Mexico State Line
Started: January 19, 1961
Type: Three grab samples per week

Date	Radium-226 pg/liter	Uranium ug/liter
1965		
August 4-August 29	0.09	2.2
August 31-September 30	0.09	2.8
October 2-October 29	0.06	1.2
October 31-November 27	0.09	2.2
November 28-December 31	0.08	2.3
1966		
January 3-January 29	0.05	1.9
January 31-February 26	0.06	2.2
February 28-April 2	0.05	0.0
April 4-April 30	0.05	1.4

RMN Station 14: San Juan River at Fruitland, New Mexico
Started: August 1, 1962
Type: One grab sample per week

Date	Radium-226 pg/liter	Uranium µg/liter
1965		
August 30-September 27	0.03	2.4
October 4-October 25	0.05	2.5
November 1-November 22	0.04	0.4
November 29-December 27	0.03	0.8
1966		
January 3-January 24	0.03	0.8
January 31-February 20	0.04	1.5
February 28-March 28	0.04	0.3
April 4-April 25	0.06	1.2

RMN Station 14S: San Juan River below Shiprock, New Mexico
Started: August 7, 1962
Type: One grab sample per week

Date	Radium-226 pg/liter	Uranium µg/liter
1965		
July 7-July 13	0.04	1.4
July 14-July 20	0.08	1.3
July 21-July 27	0.06	4.3
July 28-August 1	0.05	3.8
August 2-August 8	0.08	1.8
August 9-August 15	0.04	3.2
August 16-August 23	0.04	3.0
August 24-August 29	0.05	5.0
August 30-September 6	0.05	8.1
September 7-September 12	0.05	6.1
September 13-September 16	0.08	4.4
September 17-September 26	0.05	4.4
September 27-October 3	0.05	4.2
October 4-October 10	0.04	5.6
October 11-October 17	0.03	7.2
October 18-October 24	0.09	4.3
October 25-October 31	0.04	4.2
November 1-November 7	0.06	2.6
November 8-November 14	0.04	1.6
November 15-November 21	0.05	1.8
November 22-November 28	0.05	0.7
November 29-December 5	0.06	2.9
December 6-December 12	0.06	2.9
December 13-December 19	0.05	2.0
December 20-December 26	0.04	2.0
December 27-January 2	0.05	3.0
1966		
January 3-January 9	0.03	1.3
January 10-January 16	0.09	2.2
January 17-January 24	0.03	2.8
January 25-January 30	0.03	3.5
January 31-February 6	0.05	2.9
February 7-February 13	0.03	6.4
February 14-February 20	0.04	4.7
February 21-February 27	0.03	1.2
February 28-March 6	0.04	0.1
March 7-March 14	0.04	0.3
March 15-March 20	0.06	0.1
March 21-March 27	0.06	0.4
March 28-April 3	0.04	2.2
April 4-April 10	0.04	2.4
April 11-April 17	0.04	2.3

RMN Station 15: San Juan River above Mexican Hat, Utah
Started: December 11, 1961
Type: Three grab samples per week

Date	Radium-226 pg/liter	Uranium µg/liter
1965		
October 19-October 29	0.08	2.8
November 2-November 27	0.08	2.1
December 1-January 1	0.09	2.2
1966		
January 4-January 29	0.05	2.6
February 3-February 27	0.06	2.5
March 1-March 31	0.08	3.3
April 3-April 28	0.06	2.3

RMN Station 16: San Juan River below Mexican Hat, Utah
Started: December 11, 1961
Type: Three grab samples per week

Date	Radium-226 pg/liter	Uranium µg/liter
1965		
October 19-October 29	0.06	3.6
November 2-November 27	0.06	2.2
December 1-January 1	0.09	2.5
1966		
January 4-January 29	0.08	2.8
February 1-February 27	0.06	2.8
March 1-March 31	0.08	3.3
April 3-April 28	0.06	2.2

RMN Station 17: San Miguel River above Naturita, Colorado
Started: October 28, 1961
Type: One grab sample per week

Date	Radium-226 pg/liter	Uranium µg/liter
1965		
August 9-August 31	0.05	1.5
August 31-October 4	0.03	3.3
October 11-November 2	0.03	5.0
November 8-November 29	0.04	2.7
December 6-January 3	0.04	2.9
1966		
January 10-January 31	0.04	3.0
February 7-February 28	0.01	3.5
March 7-March 28	0.04	1.0
April 4-April 25	0.05	1.4

RMN Station 18: San Miguel River above Uravan, Colorado
Started: October 27, 1961
Type: Automatic Pump-Timer

Date	Radium-226 pg/liter	Uranium µg/liter
1965		
August 1-August 31	0.15	3.6
August 31-October 4	0.10	5.0
October 4-November 2	0.08	5.6
November 2-November 29	0.09	4.4
November 29-January 3	0.35	8.3
1966		
January 3-January 31	0.14	5.1
January 31-February 28	0.22	6.7
February 28-April 4	0.10	2.1
April 4-May 2	0.09	1.7

RMN Station 20: San Miguel River below Uravan, Colorado
Started: October 9, 1961
Type: Automatic Pump-Timer

Date	Radium-226 pg/liter	Uranium µg/liter
1965		
August 1-August 9	0.10	4.4
August 9-August 16	0.10	5.2
August 16-August 23	0.13	7.8
August 23-August 31	0.30	6.9
August 31-September 6	0.60	14
September 6-September 13	0.41	14
September 13-September 20	0.94	26
September 20-September 27	0.34	12
September 27-October 4	0.51	12
October 4-October 10	0.39	16
October 11-October 20	0.19	16
October 20-October 26	0.23	11
October 26-November 2	0.70	23
November 2-November 8	0.28	9.6
November 8-November 15	0.15	14
November 15-November 22	0.19	8.5
November 22-November 29	1.3	15
November 29-December 6	0.25	12
December 6-December 13	1.1	24
December 13-December 19	0.55	29
December 20-December 27	0.12	5.2
December 27-January 3	1.5	32
1966		
January 3-January 10	0.48	20
January 10-January 17	0.36	36
January 17-January 24	0.54	20
January 24-January 31	0.54	21
January 31-February 7	0.95	24
February 7-February 14	0.76	26
February 14-February 21	1.2	40
February 21-February 28	0.58	20
February 28-March 7	0.61	18
March 7-March 14	0.20	8.9
March 14-March 21	0.22	3.8
March 21-March 28	0.48	10
March 28-April 4	0.16	3.4
April 4-April 11	0.22	3.0
April 11-April 18	0.32	1.1
April 18-April 25	0.25	3.7
April 25-May 2	0.20	3.0

RMN Station 21: Dolores River at Bedrock, Colorado
Started: October 30, 1961
Type: Three grab samples per week

Date	Radium-226 pg/liter	Uranium µg/liter
1965		
August 2-August 27	0.26	5.3
August 30-October 1	0.59	8.3
October 4-October 29	0.26	5.8
November 1-November 26	0.25	7.0
November 29-December 31	0.21	4.2
1966		
January 3-January 28	0.16	5.0
January 31-February 25	0.21	4.8
February 28-April 1	0.14	1.8

RMN Station 26: Dolores River at Gateway, Colorado
Started: October 30, 1961
Type: Three grab samples per week

Date	Radium-226 pg/liter	Uranium µg/liter
1965		
August 2-August 27	0.48	9.5
August 30-October 1	0.66	12
October 4-October 30	0.54	14
November 1-November 27	0.73	12
November 29-January 2	0.76	13
1966		
January 4-January 29	0.86	19
January 31-February 25	1.0	17
February 28-April 1	0.45	10

RMN Station 30: Colorado River at U.S.-Mexican Border
Started: July 30, 1962
Type: One grab sample per week

Date	Radium-226 pg/liter	Uranium µg/liter
1965		
August 2-August 27	0.25	10
August 30-October 1	0.19	9.5
October 4-October 29	0.09	11
November 1-November 26	0.10	6.3
November 29-December 30	0.15	6.4
1966		
January 3-January 28	0.11	4.9
January 31-February 25	0.11	6.4
February 28-April 1	0.11	6.6
April 4-April 29	0.18	8.7

RMN Station 31: Colorado River at Page, Arizona
Started: May 1, 1963
Type: 300 cc composite per week

Date	Radium-226 pg/liter	Uranium µg/liter
1965		
August 2-August 30	0.16	3.1
September 20-September 27	0.20	2.8
October 4-October 25	0.10	3.5
November 1-November 29	0.13	3.2
December 6-December 27	0.16	4.1
1966		
January 3-January 31	0.15	4.9
February 7-February 28	0.14	5.1
March 7-March 28	0.19	5.2

RMN Station 32: Colorado River at (Lake Mead) Boulder City, Nevada
Started: March 11, 1963
Type: One grab sample per week

Date	Radium-226 pg/liter	Uranium µg/liter
1965		
August 2-August 23	0.45	9.1
August 30-September 27	0.42	11
October 4-October 18	0.51	9.0
November 1-November 22	0.54	8.5
November 29-January 3	0.52	8.3
1966		
January 7-January 24	0.60	8.0
February 14-February 28	0.40	7.6
February 28-March 28	0.42	6.3
April 4-April 25	0.41	8.4

RMN Station 33: Colorado River at Metropolitan Water District Intake, Lake Havasu, California-Arizona
Started: January 7, 1963
Type: One grab sample per week

Date	Radium-226 pg/liter	Uranium µg/liter
1965		
July 1-July 31	0.38	11
August 11-August 31	0.31	5.7
September 1-September 30	0.41	6.9
October 1-October 31	0.39	6.7
November 1-November 30	0.39	8.4
December 1-December 31	0.40	7.8
1966		
January 1-January 31	0.30	7.5
February 2-February 21	0.44	7.5
February 26-March 28	0.41	7.8
April 4-April 25	0.39	7.6